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Research Article

Floristic composition, life-forms and biological spectrum of Toor Al-Baha District, Lahej Governorate, Yemen

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ABSTRACT

This paper enumerates 542 plant species belonging to 289 genera in 89 families of vascular plants collected from Toor Al-Baha district, Lahej governorate, Yemen, during 2008-2015. The Poaceae has the, relatively highest number of species (50 sp., 9.23%) followed by Asteraceae (38 sp., 7.01%), Euphorbiaceae (34 sp., 6.27%), Asclepiadaceae (30 sp., 5.54%), Fabaceae (28 sp., 5.17%) and Acanthaceae (26 sp., 4.80%). A genus represented by the greatest number of species is *Euphorbia* (19 species). Classification based on life form indicates that the chamaephytes (38.19%) comprise the largest proportion of the plants in the study area, followed by therophytes (28.60%) and phanerophytes (20.85%). The present results revealed that there are three parasitic species belong to two families these are: *Cistanche phelypaea* and *Cistanche rosea* (Orobanchaceae) and *Striga angustifolia* (Scrophulariaceae). Sixty three succulents taxa belong to eighteen families were recorded in the flora of the study area, among these families three are the richest ones (Asclepiadaceae 17, Euphorbiaceae 11 and Aloaceae 6).

Keywords: Floristic composition; Life form; *Euphorbia*; Succulent taxa; Yemen.

1. INTRODUCTION

The Toor Al-Baha district (Fig. 1) has a special geographical, bio-geographical and ecological position in the Lahej governorate, Yemen. It extends between latitudes 12° 58’ and 13° 20’ N. and between longitudes 44° 11’ and 44° 39’ E., with an area of about 1883 sq. km. Toor Al-Baha district is bordered by Al-Qubaytah district in the north, Al-Maqatrah district, Al-Madaribah and Ras Al-Aarah district in the west, Tuban district in the east and by Gulf of Aden and parts of Aden governorate in the south (Fig. 1). The flora of Yemen is very rich and diverse. Species diversity is a result of considerable climatic changes in former periods, which enabled different species to survive, in the different ecological habitats [1]. Previous studies reported that, there are about 2844 plant species belong to 1068 genera and 179 families in Yemen [2-12]. The system of Raunkiaer is the most and worldwide accepted, which is based upon the principle of position and degree of protection of the buds during the adverse climate condition.

There are several workers on floristic composition of different regions in Yemen [2, 13-21]. Besides, no work on life forms has so far been carried out in Yemen.

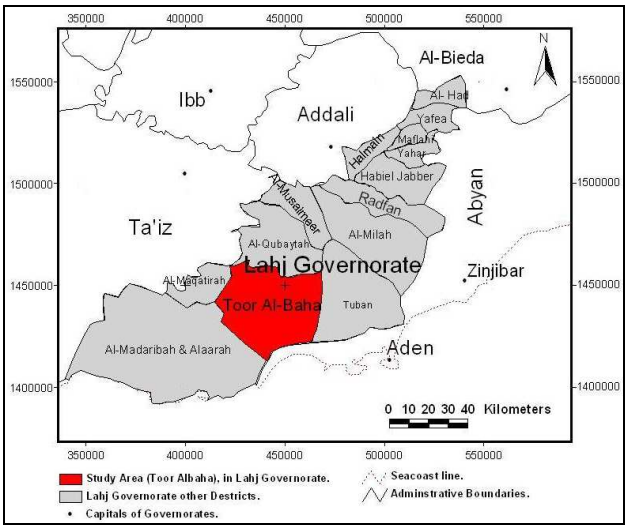

Figure 1. Map of Lahej governorate with browsing the location of study area - Toor Al-Baha district (modified after Ministry of the Local Administration).

2. MATERIALS AND METHODS

This work is based on the results of four years (2008-2015) of intensive study of the vascular plants of Toor Al-Baha district, Lahej governorate, Yemen. The plant specimens were pressed in the field and transported to be continued in the laboratory. When the species were completely dried, each individual specimen was mounted on a herbarium sheet. Specimens of all plants were identified and named with the aid of relevant floras and available revisions [3, 6, 22-54**]**. All the plants species were classified on the basis of life forms as defined by Hassib [55] and Raunkiaer [56], to determine the phytoclimate of the area. The percentage of various life form classes put together is called as the biological spectrum.

The plant taxa found in the study area are listed in Appendix. The list provides scientific name and life form.

Abbreviations

Abbreviations of life form categories used in the paper include in alphabetical order: Ch = Chamaephytes; Ep = Epiphytic; G = Geophytes; He = Hemicryptophytes; P = Parasites; Ph = Phanerophytes; Th = Therophytes; S = Succulent.

3. RESULTS

3.1. Floristic analysis

Plant species recorded in studied area (Toor Al-Baha district) with their families are listed in the Appendix. The list includes 542 species, representing 289 genera and 89 families: 81 monocots (14.94%), 452 dicots (83.39%), 8 ferns (1.48%) and one Gymnospermae (*Juniperus procera*). The richest families in terms of number of taxa are Poaceae (50), Asteraceae (38), Euphorbiaceae (34), Asclepiadaceae (30), Fabaceae (28) and Acanthaceae (26). The largest families in terms of number of genera are Poaceae (28), Asteraceae (26), Asclepiadaceae (20) and Acanthaceae (13) Appendix. The genera with the largest number of species are *Euphorbia* (19), *Acacia* (12), *Indigofera* (10), *Heliotropium* (9) and *Eragrostis* (8) (Fig. 2).

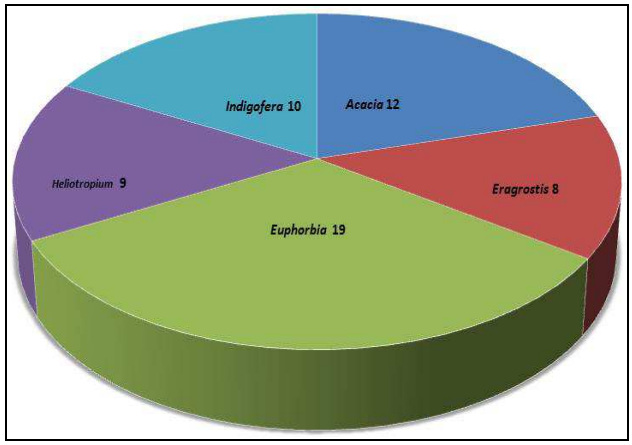

Figure 2. The richest genera in terms of number of species in studied area.

3.2. Life forms

The life form spectrum of the whole study area (Appendix), showed that the most dominant life form is chamaephytes (207 sp., with 38.19%), followed by therophytes (155 sp., 28.60%) and phanerophytes (113 sp., 20.85%). Among the flora of Toor Al-Baha the geophytes (36 sp.) were low and represent about 6.64%. On the other hand hemicryptophytes were represented by (23 sp. and

4.24%). During the field work five species were observed growing on the others plants (epiphytes or hemiparasit), these species represent 0.92% of the total recorded species. The present results revealed that there are three parasitic species belong to two families these are: *Cistanche phelypaea* and *Cistanche rosea* (Orobanchaceae) and *Striga angustifolia* (Scrophulariaceae). These three species represent 0.55% of the total collected species in the studied area (Appendix; Table 1; Fig. 3).

Table 1. Different life-forms classes of the flora of Toor Al-Baha District.

Life form classes	Abbreviation	No. of species	Percentage
Chamaephytes	Ch	207	38.19
Epiphytic	Ep	5	0.92
Geophytes	G	36	6.64
Hemicryptophytes	He	23	4.24
Parasites	P	3	0.55
Phanerophytes	Ph	113	20.85
Therophytes	Th	155	28.60
Total		542	100

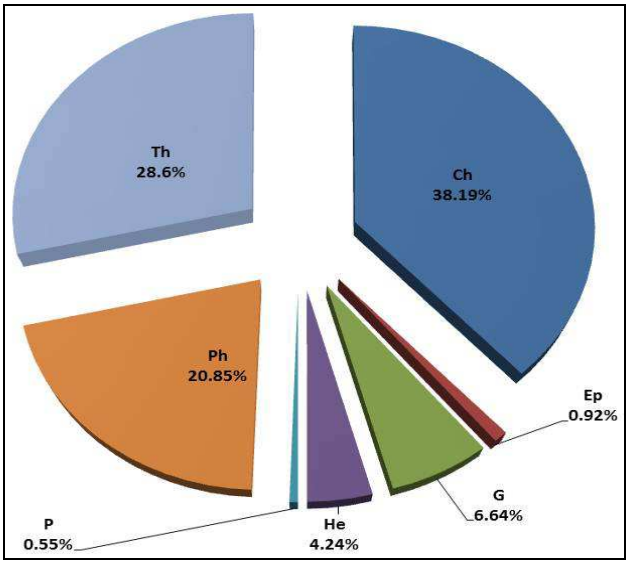

Figure 3. Biological spectrum of life-forms of present study (explanation of abbreviations in Materials and Methods).

3. 3. Succulent plants

Among the 542 species recorded in the studied area, 63 species are succulents in different parts (roots, stems and leaves). The following families comprise the high numbers of the succulent taxa: Asclepiadaceae (17), Euphorbiaceae (11), Aloaceae (6), Aizoaceae, Crassulaceae and Vitaceae (4 species for each) (Table 2).

4. DISCUSSION

The vascular flora of the Toor Al-Baha district contains a total 542 taxa (including species and infra-specific taxa) in 89 families (71 dicots, 14 monocots, three pteridophytes and one Gymnospermae) and 289 genera. The richest families in terms of number of taxa are Poaceae (50), Asteraceae (38), Euphorbiaceae (34), Asclepiadaceae (30), Fabaceae (28) and Acanthaceae (26). These families represent a high percentage (38.01%) of the total species of the studied area (Appendix). A comparison of families in terms of the number of species found in this study compared with studies of nearby regions with similar habitats [2, 14, 19, 57, 58] was done. Poaceae was the largest families in all studies except for Asteraceae in Wadi Dahr [14]. *Euphorbia* was the largest genus in terms of number of species in studied area (Fig. 2). The present results agree with the other references [2, 7, 13, 14, 58, 59].

Following the well "life form" system of [56], based on the location of renewal buds, the life form spectrum is thought to be either hereditary adjustment to environment or representing the residual effects of some historical, climatic or biotic conditions on the plant population [60]. In the present studies, the chamaephytes are the most dominant life form in the studied area. They are represented by 207 taxa which constitute about 38.19% of the recorded taxa, followed by therophytes (155 taxa, 28.60%) and the phanerophytes (113 taxa, 20.85%) (Table 1, Fig. 3).

The dominance of the chamaephytes life form, and the short life cycles plants (therophytes) may be attributed to be response to the hot dry climate, topographic variation and biotic influence, while phanerophytes provide good evidence that there abundance is fact of an expression of monsoon climate. Thus these characters of chamaephytes, therophytes and phanerophytes show dominance over the other life form. In the neighbor countries such as Taif of Saudi Arabia, Mosallam [61] reported that the dominant life form of that region

are therophytes and chamaephytes while El-Ghanim et al. [62] reported the same results from Hail region of Saudi Arabia. Abd El-Ghani and Abdel-Khalik [63] from the southeastern corner of Egypt (Elba) reported that the dominant life forms in that area are: therophytes, phanerophytes and chamaephytes. Kambhar and Kotresha [64] from Gadag district, Karnataka, India, reported that the dominant life forms of that region are (therophytes and phanerophytes).

Table 2. Numbers of succulent taxa and their families recorded in the study area (explanation of abbreviations in Materials and Methods).

Family	Life form							
	Ch (s)	G (s)	He(s)	P(s)	Ph (s)	Th (s)	Total	%
Agavaceae	-	1	-	-	-	-	1	1.59
Aizoaceae	-	-	-	-	-	4	4	6.35
Aloaceae	5	-	-	-	1	-	6	9.52
Apocynaceae	-	-	-	-	1	-	1	1.59
Asclepiadaceae	15	-	2	-	-	-	17	26.98
Asteraceae	2	-	-	-	-	-	2	3.17
Cactaceae	-	-	-	-	2	-	2	3.17
Chenopodiaceae	1	-	-	-	-	-	1	1.59
Crassulaceae	4	-	-	-	-	-	4	6.35
Dracaenaceae	-	2	-	-	-	-	2	3.17
Euphorbiaceae	8	-	-	-	3	-	11	17.46
Moraceae	1	-	-	-	-	-	1	1.59
Orchidaceae	-	1	-	-	-	-	1	1.59
Orobanchaceae	-	-	-	2	-	-	2	3.17
Passifloraceae	-	-	-	-	1	-	1	1.59
Portulacaceae	-	-	-	-	-	2	2	3.17
Vitaceae	2	-	2	-	-	-	4	6.35
Zygophyllaceae	-	-	-	-	-	1	1	1.59
Total	38	4	4	2	8	7	63	100
Percentage	60.32	6.35	6.35	3.17	12.70	11.11	100	

Epiphytic or semi-parasitic species are recorded among the flora of this region but with small percentage (0.92%). They are represented by five species. All of them are belonging to two families: Loranthaceae, four species in three genera these are: *Oncocalyx doberae* on *Dobera glabra* trees, *Phragmanthera austroarabica* on *Ficus cordata* and *Acacia asak, w*hile *Plicosepalus acaciae* on *Acacia* spp., *P. curviflorus* on *Acacia tortilis* and *Euphorbia cactus*. The fifth species is *Viscum cruciatum* which belongs to family Viscaceae was found on *Tamarix aphylla* (Table 1, Fig. 3). Another plant group, parasitic plants, the present results of Toor Al-Baha flora proved that there are three species of this group. Two species are belonging to Orobanchaceae: *Cistanche phelypaea* and *C. rosea* and only one species belonging to Scrophulariaceae (*Striga angustifolia*). This number of the parasitic species constitutes 0.55% of the total number of species recorded in the studied area. This value is insignificant. The occurrence of the parasitic species denotes the importance of water conservation. The study on the flora of Toor Al-Baha proved that there are not any aquatic plants since there are neither streams nor water bodies in the studied area. But the present studies reported of *Phyla nodiflora* (Verbenaceae) prefers the wetted soils or canal banks. Also the flora of Toor Al-Baha is very poor in the halophytes plants because its land is far away from the sea shore or costal land.

Succulent plants are of a great ecological significance, particularly in arid and semi-arid parts

of Yemen or the Arabian Peninsula in general. They store water in their stems, leaves or roots, a characteristic feature adopted by several plants to withstand high temperature and low precipitation. In Yemen, succulent plants are usually seen in, along the Aden Gulf and the Red Sea coast, shallow depressions and dry places with low altitudes. In the study area, approximately, 63 species belonging to 18 families are generally recognized as succulent. Some of the families, which are rich in succulent species, are Aizoaceae, Aloaceae, Asclepiadaceae, Crassulaceae, Euphorbiaceae, and Vitaceae (Table 2). The same results are in agreement with those of McCoy [50]. The succulent habit of the plants may be reflect the dominant climatic factors in this region since plants modify their parts leaves, stems and inflorescences to storage the available water in the wet rainy seasons to survive in the dry seasons.

All most all plants are useful in one way or the other. Economically, the flora of Toor Al-Baha comprises several plant species with high economic value. These plants can be classified into: timber plants, fibre yielding plants, edible plants and medicinal plants. People at Toor Al-Baha usually used *Juniperus, Prosopis, Tamarix, Ziziphus, Cordia, Combretum, Dracaena, Ficus, Grewia* etc. as a source of timber for construction. Pillows have been made from the inflorescence of *Aerva javanica* and mats from the fibres of *Sansevieria, Hyphaene, Phoenix* and *Dracaena.* Some other wild species are reported to be edible and are eaten in one way or the other as *Amaranthus lividus, Rumex vesicarius, Corchorus spp., Portulaca oleracea, Pulicaria jaubertii, Cissus rotundifolia, Desmidorchis awdelianus, Monolluma quadrangula, Orbea deflersiana* etc. These plants are important plants of which the fresh leaves or stem are eaten. The use of *Salvadora persica* roots as tooth-brush, myrrh from *Commiphora spp.,* henna from *Lawsonia inermis,* etc. is common even in these days. Species such as *Lawsonia inermis, Withania somnifera, Senna alexandrina, S. italica, Acacia etbaica, Jatropha curcas, Solanum incanum* etc. are good sources of medicines for treating various ailments.

AUTHOR'S CONTRIBUTION

All authors have equally contribution in fields of work, collection, identification, scrutiny of literature, manuscript preparation and editing, associated with this research article. The final manuscript has been read and approved by all authors.

TRANSPARENCY DECLARATION

The authors declare that there is no conflict of interests.

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Appendix. List of plant species recorded in the studied area with their families and life-forms (explanation of abbreviations in Materials and Methods).

Taxon	Life form
Acanthaceae (26)	
Acanthus arboreus Forssk.	Ph
Anisotes trisulcus (Forssk.) Nees	Ph
Asystasia guttata (Forssk.) Brummitt	Ch
Barleria acanthoides Vahl	Ch
Barleria hildebrandtii S. Moore	Ch
Barleria hochstetteri Nees	Ch
Barleria parviflora R. Br. ex T. Anders.	Ch
Barleria prionitis L. subsp. *appressa* (Forssk.) Brummitt & J. R. I. Wood	Ch
Barleria proxima Lindau	Ch
Barleria trispinosa (Forssk.) Vahl	Ch
Blepharis ciliaris (L.) B. L. Burtt.	Ch
Crossandra johanninae Fiori	Ch
Dyschoriste radicans Nees	Ch
Ecbolium gymnostachyum (Nees) Milne-Redh.	Ch
Ecbolium viride (Forssk.) Alston	Ch
Justicia calyculata Defl.	Th
Justicia debilis (Forssk.) Vahl	Ch
Justicia flava (Vahl) Vahl	Th
Justicia heterocarpa T. Anders. subsp. *heterocarpa*	Th
Justicia ladanoides Lam.	Th
Justicia odora (Forssk.) Lam.	Ch
Lepidagathis calycina Hochst. ex Nees	Ch
Megalochlamys violacea (Vahl) Vollesen	Ch
Peristrophe paniculata (Forssk.) Brummitt	Th
Ruellia discifolia Oliv.	Ch
Ruellia patula Jacq.	Ch
Actiniopteridaceae (2)	
Actiniopteris radiata (Swartz) Link	G
Actiniopteris semiflabellata Pic.-Ser.	G
Adiantaceae (5)	
Adiantum capillus-veneris L.	He
Adiantum incisum Forssk.	G
Cheilanthes coriacea Decne.	G
Negripteris scioana (Chiov.) Pic.-Ser.	G
Onychium divaricatum (Poir.) Alston	G
Agavaceae (1)	
Agave sisalana Perrine	G (s)
Aizoaceae (4)	
Aizoon canariense L.	Th (s)
Trianthema crystallina (Forssk.) Vahl	Th (s)
Trianthema triquetra Willd.	Th (s)
Zaleya pentandra (L.) C. Jeffrey	Th (s)
Alliaceae (1)	
Allium subhirsutum L.	G
Aloaceae (6)	
Aloe inermis Forssk.	Ch (s)
Aloe irafensis Lavranos, McCoy & Gifri	Ch (s)
Aloe niebuhriana Lavranos	Ch (s)
Aloe officinalis Forssk.	Ch (s)

Taxon	Life form
Aloe rivierei Lavranos & L. E. Newton	Ch (s)
Aloe sabaea Schweinf.	Ph (s)
Amaranthaceae (12)	
Achyranthes aspera L.	Ch
Aerva javanica (Burm. f.) Juss. ex Schult. var. *javanica*	Ch
Aerva lanata (L.) Juss. ex Schult.	Ch
Alternanthera pungens Kunth	Th
Amaranthus graecizans L. subsp. *graecizans*	Th
Amaranthus lividus L.	Th
Amaranthus sparganiocephalus Thell.	Th
Amaranthus spinosus L.	Th
Digera muricata (L.) Mart. subsp. *muricata*	Th
Psilotrichum gnaphalobryum (Hochst.) Schinz	Ch
Pupalia lappacea (L.) A. Juss. var. *velutina* (Moq.) Hook. f.	Ch
Saltia papposa (Forssk.) Moq.	Ph
Amaryllidaceae (2)	
Crinum album (Forssk.) Herb.	G
Pancratium tortuosum Herbert.	G
Anacardiaceae (2)	
Pistacia falcata Becc. ex Mart.	Ph
Rhus flexicaulis Bak.	Ph
Apiaceae (Umbelliferae) (2)	
Conium maculatum L.	Ch
Oreoschimperella arabiae-felicis (C. C. Townsend) C. C. Townsend var. *laevis* C. C. Townsend	Th
Apocynaceae (2)	
Acokanthera schimperi (DC.) Schweinf.	Ph
Adenium obesum (Forssk.) Roem. & Schult	Ph (s)
Arecaceae (Palmae) (2)	
Hyphaene thebaica (L.) Mart.	Ph
Phoenix dactylifera L.	Ph
Aristolochiaceae (1)	
Aristolochia bracteolata Lam.	Th
Asclepiadaceae (30)	
Blyttia spiralis (Forssk.) D. Field & J. R. I. Wood	Ch
Calotropis procera (Ait.) Ait. f.	Ph
Caralluma subulata (Forssk.) Decne.	Ch (s)
Cynanchum viminale (L.) L. subsp. *stipitaceum* (Forssk.) Meve & Liede	Ch (s)
Desmidorchis cf. arabicus (N. E. Br.) Meve & Liede	Ch (s)
Desmidorchis awdelianus (Defl.) Meve & Liede	Ch (s)
Desmidorchis penicillata (Defl.) Plowes	Ch (s)
Duvalia sulcata N. E. Br. subsp. *seminuda* (Lavranos) Meve	He (s)
Duvalia sulcata N. E. Br. subsp. *sulcata*	He (s)
Echidnopsis scutellata (Defl.) A. Berger subsp. *scutellata*	Ch (s)
Edithcolea sp. nov.	Ch (s)
Glossonema boveanum (Decne.) Decne.	Ch
Glossonema varians (Stocks) Benth. ex Hook. f.	Ch
Huernia rubra Plowes	Ch (s)
Leptadenia arborea (Forssk.) Schweinf.	Ch
Leptadenia pyrotechnica (Forssk.) Decne.	Ph
Marsdenia schimperi Decne.	Ph
Monolluma quadrangula (Forssk.) Plowes	Ch (s)
Odontanthera radians (Forssk.) D. V. Field	Th

Taxon	Life form
Orbea chrysostephana (Defl.) Bruyns	Ch (s)
Orbea deflersiana (Lavranos) Bruyns	Ch (s)
Pentatropis nivalis (J. F. Gmel.) D. V. Field & J. R. J. Wood	Ch
Pergularia daemia (Forssk.) Chiov.	He
Pergularia tomentosa L.	Ch
Periploca aphylla Decne.	Ph
Periploca visciformis (Vatke) K. Schum.	Ph
Rhytidocaulon splendidum T. A. McCoy	Ch (s)
Sulcolluma hexagona (Lavranos) Plowes	Ch (s)
Sulcolluma shadhbana (Lavranos) Plowes	Ch (s)
Sulcolluma shadhbana (Lavranos) Plowes var. *barhana* (Lavranos & L. E. Newton) Plowes	Ch (s)
Asparagaceae (1)	
Asparagus africanus Lam.	Ch
Asteraceae (Compositae) (38)	
Acanthospermum hispidum DC.	Th
Bidens biternata (Lour.) Merr. & Sherff	Th
Blepharispermum yemense Defl.	Ph
Blumea bovei (DC.) Vatke	Ch
Echinops erinaceous Kit Tan	Ch
Eclipta prostrata (L.) L.	He
Erigeron bonariensis L.	Ch
Flaveria trinervia (Spreng.) C. Mohr	Th
Helichrysum glumaceum DC.	Ch
Iphiona scabra DC.	Ch
Kleinia odora (Forssk.) DC.	Ch (s)
Kleinia pendula (Forssk.) DC.	Ch (s)
Laggera decurrens (Vahl) F. N. Hepper & J. R. I. Wood	Ch
Launaea intybacea (Jacq.) Beauverd	Th
Launaea massauensis (Fresen.) Sch. Bip. ex Kuntze	Th
Launaea petitiana (A. Rich.) N. Kilian	Ch
Osteospermum vaillantii (Decne.) Norl.	Th
Pegolettia senegalensis Cass.	Th
Pluchea indica (L.) Less. subsp. *indica*	Ph
Pluchea indica (L.) Less. subsp. *yemenensis* King-Jones	Ph
Pluchea ovalis (Pers.) DC.	Ch
Pseudoconyza viscosa (Mill.) D'Arcy	Th
Psiadia punctulata (DC.) Vatke	Ch
Pulicaria jaubertii Gamal-Eldin	Th
Pulicaria petiolaris Jaub. & Spach	Ch
Pulicaria schimperi DC.	Ch
Pulicaria somalensis O. Hoffm. subsp. *schweinfurthii* Gamal-Eldin	Ch
Reichardia tingitana (L.) Roth	Th
Sonchus oleraceus L.	Th
Tagetes minuta L.	Th
Tridax procumbens L.	He
Vernonia arabica F. G. Davies	Ch
Vernonia cinerascens Sch. Bib.	Ch
Vernonia cinerea (L.) Less.	Th
Vernonia spatulata (Forssk.) Sch. Bip. ex Asch.	Ch
Volutaria albicaulis (Defl.) J. R. I. Wood	Ch
Xanthium spinosum L.	Th
Xanthium strumarium L.	Ch

Taxon	Life form
Balanitaceae (1)	
Balanites aegyptiaca (L.) Delile var. *aegyptiaca*	Ph
Bignoniaceae (1)	
Rhigozum somalense Hall. f.	Ph
Boraginaceae (17)	
Arnebia hispidissma (Lehm.) DC.	Th
Cordia monoica Roxb.	Ph
Cordia nevillii Alston	Ph
Cordia sinensis Lam.	Ph
Echium rauwolfii Delile	Th
Ehretia abyssinica R. Br. ex Fresen.	Ph
Ehretia obtusifolia Hochst. ex A. DC.	Ph
Heliotropium aegyptiacum Lehm.	Ch
Heliotropium bottae Defl.	Ch
Heliotropium longiflorum (A. DC.) Jaub. & Spach var. *longiflorum*	Ch
Heliotropium ovalifolium Forssk.	Th
Heliotropium pterocarpum (DC.) Hochst. & Steud. ex Bunge	Th
Heliotropium rariflorum Stocks	Ch
Heliotropium strigosum Willd. var. *bicolor* (Hochst. & Steud.) Schwartz	Th
Heliotropium strigosum Willd. var. *cordofanum* (Hochst.) Schweinf.	Th
Heliotropium zeylanicum (Burm. f.) Lam.	Ch
Trichodesma trichodesmoides (Bunge) Gürke	Ch
Brassicaceae (Cruciferae) (5)	
Diplotaxis harra (Forssk.) Boiss.	Th
Farsetia linearis Decne. ex Boiss.	Ch
Farsetia longisiliqua Decne	Ch
Farsetia stylosa R. Br.	Ch
Schouwia purpurea (Forssk.) Schweinf.	Th
Burseraceae (5)	
Commiphora gileadensis (L.) C. Chr.	Ph
Commiphora kataf (Forssk.) Engl.	Ph
Commiphora kua (Royle) Vollesen	Ph
Commiphora myrrha (Nees) Engl.	Ph
Commiphora schimperi (O. Berg) Engl.	Ph
Cactaceae (2)	
Opuntia dillenii (Ker-Gawl.) Haw.	Ph (s)
Opuntia ficus-indica (L.) Miller	Ph (s)
Caesalpiniaceae (9)	
Delonix elata (L.) Gamble	Ph
Parkinsonia aculeata L.	Ph
Senna alexandrina Mill.	Ch
Senna holosericea (Fresen.) Greuter	Ch
Senna italica Mill.	Ch
Senna obtusifolia (L.) Irwin & Barneby	Ch
Senna occidentalis (L.) Link	Ch
Senna sophera (L.) Roxb.	Ch
Tamarindus indica L.	Ph
Capparaceae (18)	
Boscia arabica Pestalozzi	Ph
Cadaba baccarinii Chiov.	Ph
Cadaba farinosa Forssk. subsp. *farinosa*	Ph
Cadaba glandulosa Forssk.	Ph

Taxon	Life form
Cadaba heterotricha Stocks	Ph
Cadaba longifolia DC.	Ph
Cadaba rotundifolia Forssk.	Ph
Capparis cartilaginea Decne.	Ch
Cleome brachycarpa Vahl ex DC.	Th
Cleome gynandra L.	Th
Cleome paradoxa R. Br. ex DC.	Ch
Cleome scaposa DC.	Th
Cleome viscosa L.	Th
Dipterygium glaucum Decne.	Ch
Maerua angolensis DC.	Ph
Maerua crassifolia Forssk.	Ph
Maerua macrantha Gilg	Ph
Maerua oblongifolia (Forssk.) A. Rich.	Ph
Caryophyllaceae (3)	
Cometes abyssinica R. Br.	Ch
Minuartia filifolia (Forssk.) Mattf.	Th
Polycarpaea repens (Forssk.) Aschers & Schweinf.	He
Celastraceae (2)	
Maytenus parviflora (Vahl) Sebsebe	Ph
Maytenus senegalensis (Lam.) Exell	Ph
Chenopodiaceae (5)	
Chenopodium carinatum R. Br.	Th
Chenopodium murale L.	Th
Halothamnus bottae Jaub. & Spach subsp. *niger* Kothe-Heinrich	Ch
Salsola spinescens Moq.	Ch
Suaeda aegyptiaca (Hasselq.) Zohary	Ch (s)
Cistaceae (1)	
Helianthemum stipulatum (Forssk.) C. Chr.	Ch
Colchicaceae (1)	
Gloriosa revoilii (Franch.) J. C. Manning & Vinn.	G
Combretaceae (2)	
Combretum molle R. Br. ex G. Don	Ph
Terminalia brownii Fresen.	Ph
Commelinaceae (6)	
Aneilema forskalei Kunth.	Th
Commelina albescens Hassk.	He
Commelina benghalensis L.	He
Commelina erecta L.	He
Commelina forsskaolii Vahl	He
Commelina imberbis Ehrenb. ex Hassk.	He
Convolvulaceae (11)	
Convolvulus arvensis L.	He
Convolvulus hystrix Vahl	Ch
Evolvulus alsinoides (L.) L.	Ch
Hildebrandtia africana Vatke subsp. *arabica* Sebsebe	Ch
Ipomoea dichroa Choisy	Ch
Ipomoea eriocarpa R. Br.	Ch
Ipomoea nil (L.) Roth	Ch
Ipomoea obscura (L.) Ker-Gawl.	Ch
Seddera arabica (Forssk.) Choisy	Ch
Seddera latifolia Hochst. & Steud.	Ch

Taxon	Life form
Seddera virgata Hochst. & Steud.	Ch
Crassulaceae (4)	
Kalanchoe alternans (Vahl) Pers.	Ch (s)
Kalanchoe bentii Hook. f. subsp. *bentii*	Ch (s)
Kalanchoe deficiens (Forssk.) Asch. & Schweinf. var. *glabra* Raadts	Ch (s)
Kalanchoe yemensis (Defl.) Schweinf.	Ch (s)
Cucurbitaceae (12)	
Citrullus colocynthis (L.) Schrad.	He
Coccinia grandis (L.) Voigt	Ch
Corallocarpus glomeruliflorus (Defl.) Cogn.	Ch
Corallocarpus schimperi (Naud.) Hook. f.	Ch
Cucumis dipsaceus Ehrenb. ex Spach	Th
Cucumis melo L. subsp. *agrestis* (Naud.) Grebensc.	Th
Cucumis prophetarum L. subsp. *dissectus* (Naud.) C. Jeffrey	Th
Cucumis prophetarum L. subsp. *prophetarum*	Th
Cucumis pustulatus Naud. ex Hook. f.	Ch
Kedrostis foetidissima (Jacq.) Cogn.	Ch
Momordica balsamina L.	Th
Zehneria anomala C. Jeffrey	Th
Cupressaceae (1)	
Juniperus procera Hochst. ex Endl.	Ph
Cyperaceae (2)	
Cyperus falcatus Nees.	G
Cyperus rotundus L.	G
Dracaenaceae (3)	
Dracaena ombet Kotschy & Peyr.	Ph
Sansevieria ehrenbergii Schweinf. ex Bak.	G (s)
Sansevieria forskaoliana (Schult. f.) Hepper & J. R. I. Wood	G (s)
Euphorbiaceae (34)	
Acalypha ciliata Forssk.	Th
Acalypha fruticosa Forssk. var. *fruticosa*	Ch
Acalypha indica L.	Ch
Chrozophora oblongifolia (Delile) A. Juss. ex Spreng.	Ch
Croton lobatus L.	Th
Euphorbia balsamifera Ait. subsp. *adenensis* (Defl.) Bally	Ch (s)
Euphorbia cuneata Vahl subsp. *cuneata*	Ph (s)
Euphorbia fractiflexa S. Carter & J. R. I. Wood	Ch (s)
Euphorbia fruticosa Forssk.	Ch (s)
Euphorbia granulata Forssk. var. *glabrata* (Gay) Boiss.	Th
Euphorbia granulata Forssk. var. *granulata*	Th
Euphorbia greuteri N. Kilian, Kürschner & P. Hein	Ch (s)
Euphorbia heterophylla L.	Th
Euphorbia hirta L.	Th
Euphorbia inarticulata Schweinf.	Ch (s)
Euphorbia indica Lam.	Th
Euphorbia longituberculosa Boiss.	Ch (s)
Euphorbia prostrata Ait.	He
Euphorbia qarad Defl.	Ph (s)
Euphorbia schimperi Presl.	Ch (s)
Euphorbia schimperiana Scheele	Th
Euphorbia serpens Kunth	Th
Euphorbia triaculeata Forssk.	Ch (s)

Taxon	Life form
Euphorbia uzmuk S. Carter & J. R. I. Wood	Ph (s)
Flueggea virosa (Roxb. ex Willd.) Voigt.	Ph
Jatropha curcas L.	Ph
Jatropha pelargoniifolia Courb. var. *pelargoniifolia*	Ch
Jatropha spinosa Vahl	Ch
Micrococca mercurialis (L.) Benth.	Th
Phyllanthus amarus Schum. & Thonn.	Th
Phyllanthus fraternus Webster	Th
Phyllanthus maderaspatensis L.	Ch
Phyllanthus rotundifolius Willd.	Th
Ricinus communis L.	Ph
Fabaceae (28)	
Cadia purpurea (Picc.) Ait.	Ph
Crotalaria incana L.	Th
Crotalaria microphylla Vahl.	Th
Crotalaria pycnostachya Benth. subsp. *pycnostachya*	Th
Crotalaria saltiana Andr.	Th
Crotalaria senegalensis (Pers.) DC.	Th
Indigofera arabica Jaub. & Spach	Th
Indigofera argentea Burm. f.	Th
Indigofera coerulea Roxb. var. *coerulea*	Ch
Indigofera coerulea Roxb. var. *occidentalis* Gillett & Ali	Ch
Indigofera colutea (Burm. f.) Merr.	Th
Indigofera hochstetteri Bak.	Th
Indigofera oblongifolia Forssk.	Ch
Indigofera semitrijuga Forssk.	Th
Indigofera spinoflora Boiss.	Ch
Indigofera spinosa Forssk.	Ch
Microcharis tritoides (Bak.) Schrire subsp. *tritoides*	Ch
Ormocarpum yemenense Gillett	Ch
Rhynchosia minima (L.) DC. var. *prostrata* (Harv.) Meikle	He
Rhynchosia pulverulenta Stocks	He
Rhynchosia schimperi Hochst. ex Boiss.	He
Sesbania leptocarpa DC.	Ph
Tephrosia heterophylla Vatke	Ch
Tephrosia purpurea (L.) Pers. subsp. *apollinea* (Delile) Hosni & El- Karemy	Ch
Tephrosia quartiniana Cuf. ex Greuter & Burdet	Ch
Tephrosia subtriflora Hochst. ex Bak.	Th
Tephrosia uniflora Pers.	Ch
Vigna aconitifolia (Jacq.) Maréchal	Th
Gentianaceae (1)	
Centaurium pulchellum (Sw.) Druce	Th
Geraniaceae (1)	
Geranium biuncinatum Kokwaro	Th
Gisekiaceae (1)	
Gisekia pharnaceoides L. var. *alata* M. Gilbert.	Th
Hyacinthaceae (4)	
Albuca abyssinica Jacq	G
Dipcadi filifolium Bak.	G
Dipcadi serotinum (L.) Medic.	G
Dipcadi viride (L.) Moench	G

Taxon	Life form
Lamiaceae (Labiatae) (17)	
Endostemon tenuiflorus (Benth.) M. Ashby	Th
Lavandula dhofarensis A. G. Miller	Th
Lavandula pubescens Decne.	Ch
Lavandula setifera T. Anders.	Ch
Leucas alba (Forssk.) Sebald	Th
Leucas glabrata (Vahl) R. Br. var. *glabrata*	Ch
Leucas inflata Benth.	Ch
Leucas urticifolia (Vahl) Sm. var. *urticifolia*	Th
Micromeria imbricata (Forssk.) C. Chr.	Ch
Ocimum filamentosum Forssk.	Ch
Ocimum forsskaolii Benth.	Ch
Ocimum spicatum Defl.	Ch
Ocimum tenuiflorum L.	Ch
Otostegia fruticosa (Forssk.) Schweinf. ex Penz. subsp. *fruticosa*	Ch
Plectranthus hyemalis J. R. I. Wood	Ch
Plectranthus montanus Benth.	Ch
Teucrium yemense Defl.	Ch
Linaceae (1)	
Linum volkensii Engl.	Th
Loranthaceae (4)	
Oncocalyx doberae (Schweinf.) A. G. Miller & J. A. Nyberg	Ep
Phragmanthera austroarabica A. G. Miller & J. A. Nyberg	Ep
Plicosepalus acaciae (Zucc.) Wiens & Polh.	Ep
Plicosepalus curviflorus (Benth. ex Oliv.) Tieghem	Ep
Lythraceae (1)	
Lawsonia inermis L.	Ph
Malvaceae (17)	
Abutilon bidentatum A. Rich.	Ch
Abutilon figarianum Webb	Ch
Abutilon fruticosum Guill. & Perr.	Ch
Cienfuegosia welshii (T. Anders.) Garcke	Ch
Gossypium arboreum L.	Ph
Hibiscus aristaevalvis Garcke	Th
Hibiscus cannabinus L.	Th
Hibiscus micranthus L. f.	Ch
Hibiscus palmatus Forssk.	Ch
Hibiscus purpureus Forssk.	Ch
Hibiscus trionum L.	Ch
Hibiscus vitifolius L.	Ch
Pavonia arabica Hochst. & Steud. ex Boiss.	Ch
Pavonia flavoferruginea (Forssk.) Hepper & J. R. I. Wood	Ch
Senra incana Cav.	Ch'
Sida alba L.	Ch
Sida ovata Forssk.	Ch
Meliaceae (2)	
Azadirachta indica A. Juss.	Ph
Turraea parvifolia Defl.	Ph
Menispermaceae (1)	
Cocculus pendulus (J. R. & G. Forst.) Diels	Ph
Mimosaceae (14)	
Acacia asak (Forssk.) Willd.	Ph

Taxon	Life form
Acacia edgeworthii T. Anders.	Ph
Acacia ehrenbergiana Hayne	Ph
Acacia etbaica Schweinf. subsp. *uncinata* Brenan	Ph
Acacia hamulosa Benth.	Ph
Acacia hunteri Oliv.	Ph
Acacia johnwoodii Boulos	Ph
Acacia laeta R. Br. ex Benth.	Ph
Acacia mellifera (Vahl) Benth.	Ph
Acacia nilotica (L.) Willd. ex Delile subsp. *indica* (Benth.) Brenan	Ph
Acacia oerfota (Forssk.) Schweinf.	Ph
Acacia tortilis (Forssk.) Hayne subsp. *tortilis*	Ph
Prosopis cineraria (L.) Druce	Ph
Prosopis juliflora (Sw.) DC.	Ph
Molluginaceae (4)	
Corbichonia decumbens (Forssk.) Exell	Th
Glinus lotoides L.	Ch
Limeum obovatum Vicary	Th
Mollugo cerviana (L.) Ser.	Th
Moraceae (8)	
Dorstenia barnimiana Schweinf.	G
Dorstenia foetida (Forssk.) Schweinf. subsp. *foetida*	Ch (s)
Ficus cordata Thunb. subsp. *salicifolia* (Vahl) C. C. Berg	Ph
Ficus glumosa Delile	Ph
Ficus ingens (Miq.) Miq.	Ph
Ficus palmata Forssk. subsp. *palmata*	Ph
Ficus sycomorus L. subsp. *sycomorus*	Ph
Ficus vasta Forssk.	Ph
Moringaceae (1)	
Moringa peregrina (Forssk.) Fiori	Ph
Nyctaginaceae (7)	
Boerhavia diffusa L.	Ch
Boerhavia elegans Choisy	Ch
Boerhavia erecta L.	Th
Commicarpus grandiflorus (A. Rich.) Standl.	Ch
Commicarpus helenae (J. A. Schultes) Meikle	Ch
Commicarpus mistus Thulin	Ch
Commicarpus plumbagineus (Cav.) Standl.	Ch
Oleaceae (2)	
Jasminum grandiflorum L. subsp. *floribundum* (R. Br. ex Fresen.) P. S. Green	Ch
Olea europaea L. subsp. *cuspidata* (Wall. ex G. Don) Ciferri	Ph
Orchidaceae (1)	
Eulophia petersii (Reichb. f.) Reichb. f.	G (s)
Orobanchaceae (2)	
Cistanche phelypaea (L.) Cout.	P (s)
Cistanche rosea Bak.	P (s)
Oxalidaceae (1)	
Oxalis corniculata L.	G
Papaveraceae (2)	
Argemone mexicana L.	Th
Argemone ochroleuca Sweet	Th
Passifloraceae (1)	
Adenia venenata Forssk.	Ph (s)

Taxon	Life form
Pedaliaceae (1)	
Pedalium murex L.	Th
Plantaginaceae (1)	
Plantago lanceolata L.	Th
Poaceae (Gramineae) (50)	
Aeluropus lagopoides (L.) Trin. ex Thwaites	G
Aristida abnormis Chiov.	Th
Aristida adscensionis L.	Th
Aristida ferrilateris S. M. Phillips	Th
Aristida mutabilis Trin. & Rupr.	Th
Arundo donax L.	G
Brachiaria lata (Schumach.) C. E. Hubb.	Th
Brachiaria leersioides (Hochst.) Stapf	Th
Brachiaria ovalis Stapf	Th
Cenchrus ciliaris L.	Th
Cenchrus pennisetiformis Hochst. & Steud.	Th
Chloris barbata Swartz	Ch
Chrysopogon plumulosus Hochst.	G
Cymbopogon schoenanthus (L.) Spreng.	G
Dactyloctenium aegyptium (L.) Willd.	Th
Dactyloctenium aristatum Link	Th
Dactyloctenium robecchii (Chiov.) Chiov.	G
Dactyloctenium scindicum Boiss.	G
Dichanthium foveolatum (Delile) Roberty	Th
Digitaria abyssinica (Hochst. ex A. Rich.) Stapf	Th
Digitaria ciliaris (Retz.) Koeler	Th
Digitaria pennata (Hochst.) T. Cooke	Th
Echinochloa colona (L.) Link	Th
Echinochloa pyramidalis (Lam.) Hitchc. & Chase	Th
Enneapogon persicus Boiss	Th
Eragrostis aspera (Jacq.) Nees	Th
Eragrostis barrelieri Daveau	Th
Eragrostis cilianensis (All.) Vignolo ex Janch.	Th
Eragrostis ciliaris (L.) R. Br.	Th
Eragrostis lepida (A. Rich.) Hochst. ex Steud.	Th
Eragrostis minor Host	Th
Eragrostis papposa (Roem. & Schult.) Steud.	Th
Eragrostis tremula (Lam.) Hochst. ex Steud.	Th
Hyparrhenia hirta (L.) Stapf	Th
Lasiurus scindicus Henrard	Th
Leptothrium senegalense (Kunth) Clayton	Th
Melinis repens (Willd.) Zizka	Th
Ochthochloa compressa (Forssk.) Hilu	G
Odyssea mucronata (Forssk.) Stapf	Ch
Panicum turgidum Forssk.	G
Paspalum dilatatum Poir.	G
Pennisetum setaceum (Forssk.) Chiov.	Ch
Setaria verticillata (L.) P. Beauv.	Th
Sporobolus angustifolius A. Rich.	Ch
Stipagrostis ciliata (Desf.) De Winter	Th
Stipagrostis plumosa (L.) Munro ex T. Anders.	Th
Tetrapogon cenchriformis (A. Rich.) Clayton	Th

Taxon	Life form
Tetrapogon tenellus (K. D. Koenig ex Roxb.) Chiov.	G
Tetrapogon villosus Desf.	G
Tragus berteronianus Schult.	Th
Polygalaceae (4)	
Polygala abyssinica R. Br. ex Fresen.	Ch
Polygala erioptera DC.	Th
Polygala irregularis Boiss.	Ch
Polygala senensis Klotzsch	Ch
Polygonaceae (2)	
Calligonum comosum Herit.	Ph
Rumex vesicarius L.	Th
Portulacaceae (2)	
Portulaca oleracea L. subsp. *oleracea*	Th (s)
Portulaca quadrifida L.	Th (s)
Primulaceae (2)	
Anagallis arvensis L. subsp. *arvensis* var. *coerulea* Gouan	Th
Anagallis arvensis L. subsp. *foemina* (Mill.) Schinz & Thell.	Th
Resedaceae (2)	
Ochradenus baccatus Delile	Ph
Reseda sphenocleoides Defl.	Ch
Rhamnaceae (2)	
Ziziphus mucronata Willd.	Ph
Ziziphus spina-christi (L.) Desf.	Ph
Rubiaceae (4)	
Kohautia aspera (Heyne ex Roth) Bremek.	Ch
Kohautia caespitosa Schnizl.	Ch
Pavetta longiflora Vahl subsp. *longiflora*	Ph
Wendlandia arabica Defl. subsp. *arabica*	Ph
Salvadoraceae (2)	
Dobera glabra (Forssk.) Poir.	Ph
Salvadora persica L.	Ph
Sapindaceae (2)	
Allophylus rubifolius (Hochst. ex A. Rich.) Engl. var. *rubifolius*	Ph
Pappea capensis Eckl. & Zeyh.	Ph
Sapotaceae (2)	
Mimusops laurifolia (Forssk.) Friis	Ph
Sideroxylon mascatense (A. DC.) Pennington	Ph
Scrophulariaceae (11)	
Anticharis arabica Endl.	Th
Anticharis glandulosa Aschers.	Th
Anticharis senegalensis (Walp.) Bhandari	Th
Campylanthus junceus Edgew.	Ch
Campylanthus yemenensis A. G. Miller	Ch
Kickxia scalarum Schweinf. ex D. A. Sutton	Ch
Kickxia woodii D. A. Sutton*	Ch
Schweinfurthia pedicellata (T. Anders.) Balf. f.	Th
Schweinfurthia pterosperma (A. Rich.) A. Braun	Th
Scrophularia arguta Sol.	Th
Striga angustifolia (D. Don.) C. J. Saldanha	P
Selaginellaceae (1)	
Selaginella imbricata (Forssk.) Spreng.	G

Taxon	Life form
Solanaceae (14)	
Datura innoxia Miller	Ch
Datura metel L.	Ch
Datura stramonium L.	Ch
Lycium shawii Roem. & Schult.	Ph
Nicotiana glauca R. C. Graham	Ph
Physalis angulata L.	Th
Solanum coagulans Forssk.	Th
Solanum cordatum Forssk.	Th
Solanum forsskaolii Dunal	Th
Solanum glabratum Dunal	Ch
Solanum incanum L.	Ch
Solanum nigrum L.	Th
Solanum villosum Miller subsp. *miniatum* (Bernh. ex Willd.) Edmonds	Th
Withania somnifera (L.) Dunal	Ch
Sterculiaceae (3)	
Melhania denhamii R. Br.	Ch
Melhania stipulosa J. R. I. Wood	Ch
Sterculia africana (Lour.) Fiori	Ph
Tamaricaceae (1)	
Tamarix aphylla (L.) Karst.	Ph
Thymelaeaceae (1)	
Gnidia somalensis (Franch.) Gilg	Ch
Tiliaceae (10)	
Corchorus depressus (L.) Stocks	Ch
Corchorus tridens L.	Th
Corchorus trilocularis L.	Th
Grewia arborea (Forssk.) Lam.	Ph
Grewia erythraea Schweinf.	Ph
Grewia schweinfurthii Burrett	Ph
Grewia tembensis Fresen.	Ph
Grewia tenax (Forssk.) Fiori	Ph
Grewia trichocarpa Hochst. ex A. Rich.	Ph
Grewia velutina (Forssk.) Vahl	Ph
Ulmaceae (1)	
Celtis africana Burm. f.	Ph
Urticaceae (3)	
Forsskaolea tenacissima L.	Ch
Forsskaolea viridis Webb	Th
Parietaria debilis G. Forster	Th
Velloziaceae (1)	
Xerophyta arabica (Bak.) N. Menezes	G
Verbenaceae (5)	
Chascanum marrubifolium Fenzl ex Walp.	Ch
Lantana camara L.	Ph
Lantana viburnoides (Forssk.) Vahl	Ch
Phyla nodiflora (L.) Greene	G
Priva adhaerens (Forssk.) Chiov.	Ch
Viscaceae (1)	
Viscum cruciatum Sieb. ex Boiss.	Ep
Vitaceae (4)	
Cissus quadrangularis L.	He (s)

Taxon	Life form
Cissus rotundifolia (Forssk.) Vahl	He (s)
Cyphostemma digitatum (Forssk.) Descoings	Ch (s)
Cyphostemma ternatum (J. F. Gmel.) Descoings	Ch (s)
Zygophyllaceae (7)	
Fagonia indica Burm. f. var. *indica*	Ch
Fagonia indica Burm. f. var. *schweinfurthii* Hadidi	Ch
Fagonia paulayana Wagner & Vierh.	Ch
Tetraena simplex (L.) Beier & Thulin	Th (s)
Tribulus macropterus Boiss. var. *arabicus* (Hosni) Al-Hemaid & J. Thomas	He
Tribulus pentandrus Forssk.	He
Tribulus terrestris L.	He